

## *Plagiothecium lucidum* (Hook. f. & Wils.) Paris in tropical Africa

Ryszard Ochyra<sup>1</sup>, Rafa Kempa<sup>2</sup>, William R. Buck<sup>3</sup>

<sup>1</sup>Laboratory of Bryology, Institute of Botany, Polish Academy of Sciences, ul. Lubicz 46, PL-31-512 Kraków, Poland ([R.Ochyra@ib-pan.krakow.pl](mailto:R.Ochyra@ib-pan.krakow.pl))

<sup>2</sup>Ul. Romanowicza 10, PL-33-100 Tarnów, Poland

<sup>3</sup>Institute of Systematic Botany, New York Botanical Garden, Bronx, NY 10458-5126, U.S.A. ([bbuck@nybg.org](mailto:bbuck@nybg.org))

**Abstract:** *Plagiothecium lucidum* (Hook. f. & Wils.) Paris is confirmed as a new addition to the bryoflora of tropical Africa on the basis of two collections from the Bale Mountains in Ethiopia. The type material of *Isopterygium integrifolium* Bartr. from Costa Rica in Central America is evaluated and this species is considered to be conspecific with *P. lucidum*. As a result of this taxonomic conclusion the range of this species is extended to Costa Rica and this is the first recognition of this species in the Central American isthmus. A world distribution map for this species is presented and some details of African plants and the type of *I. integrifolium* are illustrated.

The moss genus *Plagiothecium* Schimp. is not a prominent constituent of the moss flora in tropical Africa. Its species are mostly confined in distribution to the mountains where they occur from lower montane to subalpine belts, and only occasionally are they found in the lowlands. O'Shea (1999) recorded nine species of *Plagiothecium* from sub-Saharan Africa and the adjacent East African Indian Ocean islands including the two species reported without closer

locality data by Miehe and Miehe (1994a) from Ethiopia, namely *P. lucidum* (Hook. f. & Wils.) Paris and *P. neckeroideum* Schimp. However, he overlooked *P. alluaudii* Thér. from the Ruwenzori Mts., a poorly known species which apparently has not been examined since its description. This species and several others described by Thériot (1924) were also overlooked by the authors of earlier checklists of central African mosses (Demaret 1940, 1946, Born et al. 1993).

The final number of *Plagiothecium* species in Africa cannot be precisely established because the genus has not yet been revised taxonomically for the region, other than brief accounts by Buck (1993) and Ochyra (1993) in which some possible synonymy was suggested. However, a taxonomic revision of the genus in sub-Saharan Africa is in progress and it should provide a detailed taxonomic assessment of its species and phytogeographical affinities.

Almost all African members of *Plagiothecium* are local species, although in the light of frequent bryogeographical connections between the montane floras of Africa and the Neotropics (cf. Frahm 1982, Buck & Griffin 1984), one might expect to find disjunct species in the cosmopolitan genus *Plagiothecium*. In the early 1990s the senior author examined a large collection of mosses from the Bale Mts. in Ethiopia made by Drs Sabine and Georg Miehe, then Göttingen, now Marburg, Germany. As a result, among other interesting moss records, two specimens of *P. lucidum* were encountered. The details of these records are as follows:

ETHIOPIA. Bale Mts., above Goba, 6°54'N, 39°56'E, alt. 3500 m; Ericaceous belt: *Philippia* woodlands and thicket merging with upper montane *Philippia*–*Hagenia* forest, grazed *Ph. keniensis* scrub forest on 25° E to SSE-facing slopes in deep valley, common epiphytic moss; 2 Mar 1990, S. & G. Miehe 3064 & 3135 (KRAM, NY).

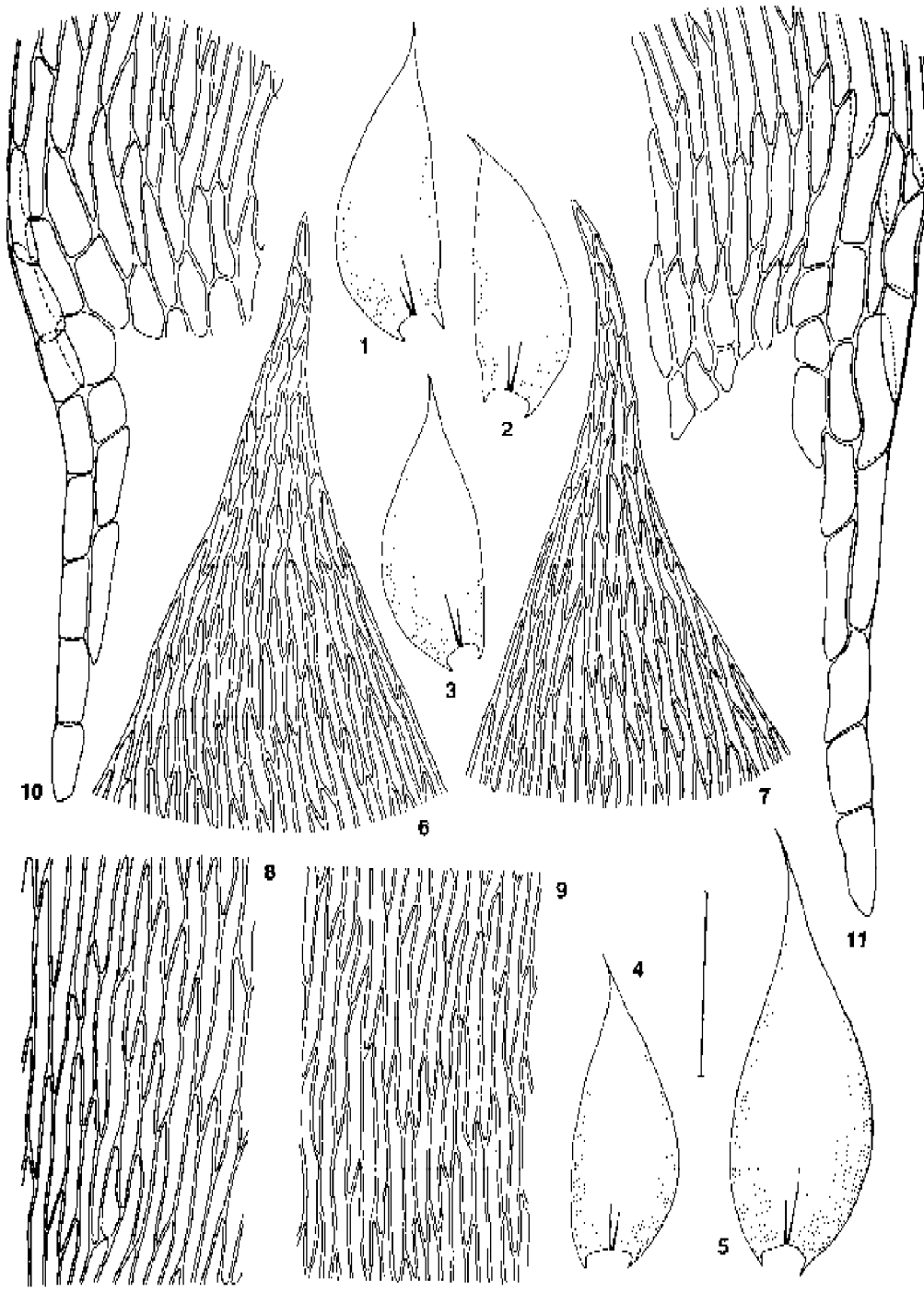
*Plagiothecium lucidum* was collected in the Bale Mts. which belong to the Bale-Arsi Massif forming the western section of the southeastern Ethiopian highlands. The massif is of volcanic origin resulting from Oligocene eruptions and at present its landscape is dominated with trachyte and basalt rocks. *Plagiothecium lucidum* grows as an epiphyte in the humid forest with *Erica trimera* and *Juniperus procera* at an elevation of 3500 m and its associates are *Hypnum cupressiforme* Hedw., *Rhynchostegium volkensis* (Broth.) Paris, *Leptodontium viticulosoides* (P. Beauv.) Wijk & Marg. and *Chiloscyphus difformis* (Nees) Engel & Schust. This community is characterized by a relatively high humidity resulting in the

development of a rich bryophyte vegetation (Miehe & Miehe 1993, 1994a, b). Epiphytic populations of *P. lucidum* are known from other parts of its range, although it grows primarily on humus, soil and moist rocks covered with soil.

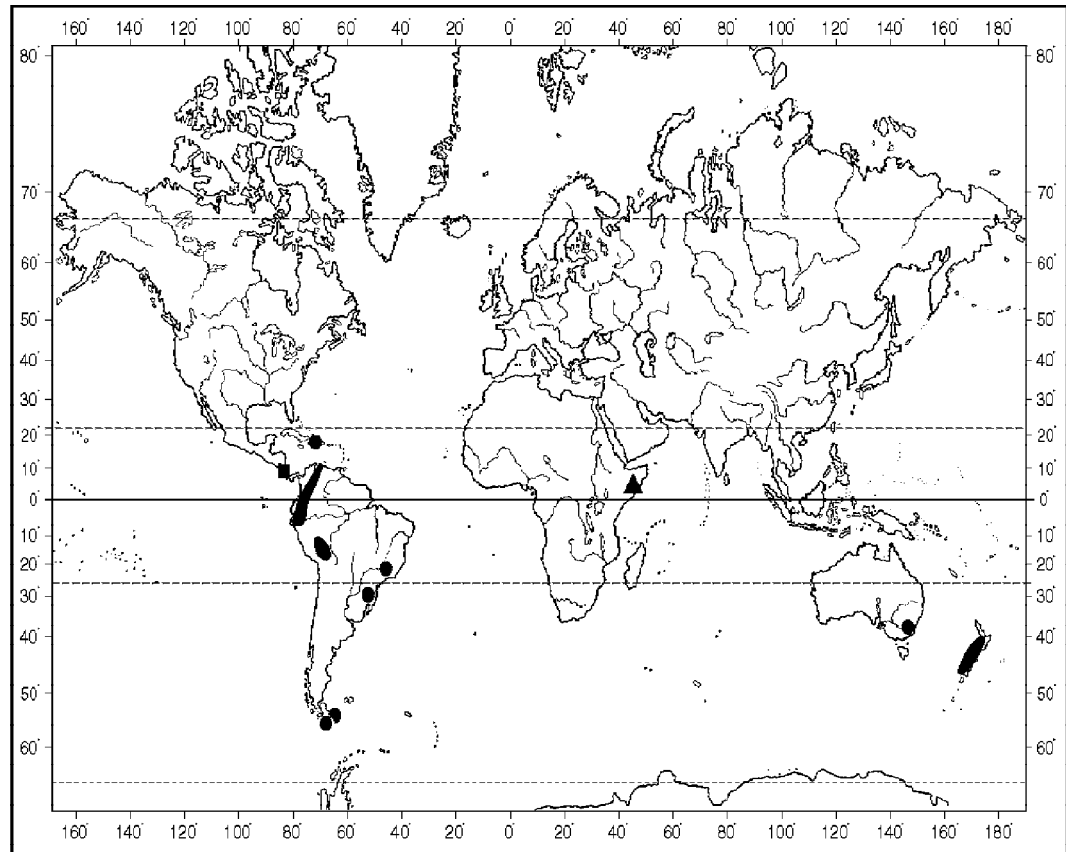
*Plagiothecium lucidum* is a very distinct species easily known by its narrowly ovate leaves with slender, long acuminate apices and narrow laminal cells, 5–8 µm wide (Fig. 1). The plants are medium-sized and grow in complanate thin mats and are in fine fruiting condition. In contrast to American plants, no flagelliform branches have been observed in Ethiopian material. In Africa, like elsewhere, *P. lucidum* can hardly be confused with other species. *Plagiothecium nitidifolium* (Mitt.) Jaeg. is similar to this species in its acuminate leaves and narrow laminal cells, (5.5–)6.5–10 µm wide, but the presence a group of thin-walled nematogen cells at the leaf apex immediately distinguishes these two species. In the width of the laminal cells *P. lucidum* is similar to *P. neckeroideum*, but this species has a broadly acute leaf apex with a large group of nematogen cells and broadly ovate leaves.

*Plagiothecium lucidum* is an amphipacific south-temperate species (Fig. 2). It is widely distributed along the Andean chain from Tierra del Fuego to Colombia and Venezuela, with isolated stations in the Dominican Republic in the West Indies and in southeastern Brazil (Buck & Ireland 1989). It should be noted that the species is rare and occasional in the Fuegian region from whence it was originally described (Hooker & Wilson 1844) but it deeply penetrates into the tropics and is relatively frequent in the central and northern Andes from Bolivia to Venezuela, occurring mostly at elevations of 2000–4120 m in the paramo vegetation (Churchill & Griffin 1999) and rarely descending to lower altitudes. The second center of this species is Australasia where it is widely distributed on the South Island and rather rare on the North Island of New Zealand and additionally it has been recorded once from southeastern Australia (Ireland 1992).

The discovery of *Plagiothecium lucidum* in Ethiopia is a major range extension of this austral moss. It confirms the well known and documented bryogeographical fact of the strong connections of the moss floras of the Old and New Worlds. Buck and Griffin (1984) listed a



**Fig. 1:** *Plagiothecium lucidum* (Hook. f. & Wils.) Paris. **1–5:** Leaves. **6–7:** Leaf apices. **8–9:** Mid-leaf cells. **10–11:** Alar cells (1–3, 7, 9, 11 drawn from Standley & Valerio 43764, isotype of *Isopterygium integrifolium*, FH; from Miehe 3135, KRAM; 4–6, 8, 10). Scale bar: 1 mm (1–5) and 100  $\mu$ m (6–11).



**Fig. 2:** Global distribution map for *Plagiothecium lucidum* (Hook. f. & Wils.) Paris. The African locality is marked by the triangle and the Costa Rican station by the square.

number of African–South American bryophyte disjuncts which they divided into three categories, namely (1) lowland-lower montane taxa; (2) montane to paramo/elfin forest taxa; (3) austral temperate and/or antipodal taxa. Since the publication of this list, the recognition of Afro-American disjunct species has markedly increased with progress in taxonomic studies and exploration of under-collected areas. The most spectacular examples of recently discovered disjuncts include, among others, *Orthotrichum aequatoreum* Mitt. (Lewinsky 1984), *Squamidium brasiliense* (Hornsch.) Broth. (Allen & Crosby 1986), *Rigodium toxarion* (Schwaegr.) Jaeg.

(Zomlefer 1993), *Levierella perserrata* P. Varde & Leroy (Delgadillo & Buck 1988) and *Tristichium mirabile* (Müll. Hal.) Herz. (Magill 1981, Ochyra & Sharp 1988). *Plagiothecium lucidum* represents the third category, comprising antipodal temperate species which to various degrees penetrate into the tropics. It exhibits an amphipacific distribution pattern as defined by Engel (1978, 1990) and Ochyra (1998) which is relatively rare among mosses.

During the course of the present work in Africa we re-examined the type of *Isopterygium integrifolium* Bartr. This species was described by Bartram (1928) from Costa Rica and Buck and

Ireland (1989) reduced its name to synonymy with *Plagiothecium drepanophyllum* Ren. & Card. This species is primarily characterized by having wider laminal cells, 8–11(–14)  $\mu\text{m}$  wide, only occasionally with some cells to 6  $\mu\text{m}$ , and narrowly acute leaves. Examination of the original collection of *I. integrifolium* revealed that this species is rather different from *P. drepanophyllum* but it is a quite typical expression of *P. lucidum*. The leaves are narrowly ovate and gradually tapering to a long, slender acumen (Fig. 1.1–3, 7) and the laminal cells are very narrow, 5–6  $\mu\text{m}$  wide, and only occasionally are some cells to 8  $\mu\text{m}$  wide (Fig. 1.9). Bartram (1928) described the leaves as lacking alar cells and non-decurrent, but actually they have narrow decurrencies 1–2 cells wide (Fig. 1.11). All these features are typical of *P. lucidum*, not *P. drepanophyllum*, and accordingly the following new synonymy is proposed.

***Plagiothecium lucidum*** (Hook. f. & Wils.) Paris Ind. Bryol. 962. 1897.

*Isopterygium integrifolium* Bartr., Contr. U. S. Nat. Herb. 26: 111, f. 38. 1928. — Type: On tree, Cerro de las Vueltas, Province of San José, Costa Rica, altitude 2,700 to 3,000 meters, Paul C. Standley and Juvela Valerio, December 29, 1925 to January 1, 1926, no. 43764 [Holotype: "Plants of Costa Rica" *Isopterygium integrifolium* Bartr. sp. nov. On tree Cerro de las Vueltas, Provincia de San José, altitude 2700–3000 meters. No. 43764 Paul C. Standley and Juvela Valerio, Collectors, Dec. 29, 1925. – Jan. 1, 1926." – US!; isotypes: FH-Bartr!, NY (2 specimens)!], *syn. nov.*

This taxonomic conclusion implies that *Plagiothecium lucidum* extends its geographical range to Costa Rica and in fact this is the first record of the species from the Central American isthmus (Fig. 2).

#### Acknowledgements

We would like to heartily thank Drs Sabine and Georg Miede, Marburg, Germany, for making available for study their Ethiopian moss collection. We are also grateful to the Curators at FH and US for kindly allowing us to study the type material of *Isopterygium integrifolium*. Thanks are also due to Halina Bednarek-Ochyra for her illustrations and to Katarzyna Biłczyk for generating the distribution map.

#### References

- Allen, B. & Crosby, M. R. 1986. Revision of the genus *Squamidium* (Musci: Meteoriaceae). *Journal of the Hattori Botanical Laboratory* 61: 423–476.
- Bartram, E. B. 1928. Costa Rican mosses collected by Paul C. Standley in 1924–1926. *Contributions from the United States National Herbarium* 26(3): i–x + 51–114.
- Born, S., Frahm, J.-P., & Pócs, T. 1993. Taxonomic results of the BRYOTROP expedition to Zaire and Rwanda. 26. A new checklist of the mosses of Central Africa. *Tropical Bryology* 8: 223–273.
- Buck, W. R. 1993. Taxonomic results of the BRYOTROP Expedition to Zaire and Rwanda. 24. Leskeaceae, Brachytheciaceae, Stereophyllaceae, Plagiotheciaceae, Entodontaceae, Sematophyllaceae p. pte, Hypnaceae. *Tropical Bryology* 8: 199–217.
- Buck, W. R. & Griffin, D. III. 1984. *Trachyphyllum*, a moss genus new to South America with notes on African–South American bryogeography. *Journal of Natural History* 18: 63–69.
- Buck, W. R. & Ireland, R. R. 1989. Plagiotheciaceae. *Flora Neotropica Monograph* 50: 1–22.
- Churchill, S. P. & Griffin, D. III. 1999. Mosses. In: J. L. Luteyn (ed.), *Páramos: A checklist of plant diversity, geographical distribution, and botanical literature. Memoirs of the New York Botanical Garden* 84: 53–64.
- Delgadillo, C. M. & Buck, W. R. 1988. *Levierella* (Fabroniaceae), a moss genus new to the Americas. *The Bryologist* 91: 53–55.
- Demaret, F. 1940. Prodrome des bryophytes du Congo Belge et du Ruwanda-Burundi. I. Musci. *Bulletin du Jardin Botanique de l'État Bruxelles* 16(1): 21–104.
- Demaret, F. 1946. Prodrome des bryophytes du Congo Belge et du Ruwanda-Burundi. I. Musci, supplément I. *Bulletin du Jardin Botanique de l'État Bruxelles* 18(1–2): 7–66.
- Engel, J. J. 1978. A taxonomic and phytogeographic study of Brunswick Peninsula (Strait of Magellan). Hepaticae and Anthocerotae. *Fieldiana, Botany* 41: 1–319.
- Engel, J. J. 1990. Falkland Islands (Islas Malvinas). Hepaticae and Anthocerotophyta: a taxonomic and phytogeographic study. *Fieldiana, Botany, New Series* 25: 1–209.
- Frahm, J.-P. 1982. Grossdisjunktionen von Arealen südamerikanischer und afrikanischer *Campylopus*-Arten. *Lindbergia* 8: 45–52.

- Hooker, J. D. & Wilson, W. 1844.** Musci antarctici; being characters with brief descriptions of the new species of mosses discovered during the voyage of H. M. discovery ships, *Erebus* and *Terror*, in the southern circumpolar regions, together with those of Tasmania and New Zealand. *London Journal of Botany* 3: 533–556.
- Ireland, R. R. 1992.** Studies of the genus *Plagiothecium* in Australasia. *The Bryologist* 95: 221–224.
- Lewinsky, J. 1984.** *Orthotrichum* Hedw. in South America. 1. Introduction and taxonomic revision of taxa with immersed stomata. *Lindbergia* 10: 65–94.
- Magill, R. E. 1981.** Sphagnaceae – Grimmiaceae. In: E. O. Leistner (ed.), Flora of southern Africa which deals with the territories of South Africa, Transkei, Lesotho, Swaziland, Bophuthatswana, South West Africa/Namibia, Botswana and Venda. Bryophyta. Part 1. Mosses. Pretoria: Botanical Research Institute, pp. i–xv + 1–191.
- Miehe, G. & Miehe, S. 1993.** On the physiognomic and floristic differentiation of ericaceous vegetation in the Bale Mountains, SE Ethiopia. In: I. Friis, B. Jonsell & I. Nordal (eds.), Mountains botany studies dedicated to Olov Hedberg. *Opera Botanica* 121: 85–117.
- Miehe, G. & Miehe, S. 1994a.** Ericaceous forest and heathlands in the Bale Mountains of South Ethiopia. Ecology and man's impact. Hamburg: Stiftung Walderhaltung in Africa and Bundesforschungsanstalt für Forst- und Holzwirtschaft, 206 p.
- Miehe, G. & Miehe, S. 1994b.** East African bryophytes, XII. Bryophytes from the Bale Mountains, SE Ethiopia. 1. Phyto-ecological introduction. In: R. Ochyra (ed.), Festschrift commemorating the seventieth birthday of Stanisław Lisowski. *Fragmenta Floristica et Geobotanica* 39: 165–219.
- Ochyra, R. 1993.** Taxonomic results of the BRYOTROP Expedition to Zaire and Rwanda. 20. Grimmiaceae, Funariaceae, Bartramiaceae (*Philonotis*), Amblystegiaceae, Plagiotheciaceae. *Tropical Bryology* 8: 181–187.
- Ochyra, R. 1998.** The moss flora of King George Island, Antarctica. Cracow: Polish Academy of Sciences, W. Szafer Institute of Botany: p. xxiv + 279.
- Ochyra, R. & Sharp, A. J. 1988.** Results of a bryogeographical expedition to East Africa in 1968, IV. *Journal of the Hattori Botanical Laboratory* 65: 335–377.
- O'Shea, B. J. 1999.** Checklist of the mosses of sub-Saharan Africa (version 3, 11/99). *Tropical Bryology Research Reports* 1: 1–133.
- Thériot, I. 1924.** Musci novi africani. *Bulletin du Muséum National d'Histoire Naturelle* 30: 229–246.
- Zomlefer W. B. 1993.** A revision of *Rigodium* (Musci: Rigodiaceae). *The Bryologist* 96: 1–72.